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A P A C  
The **Power** of **Data**



# **Power Generation – Leveraging Technology to Optimize Operations and Maintenance**

Presented by **David Thomason, Business Development Executive  
(Generation), OSIsoft LLC**



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# The Power of Data.

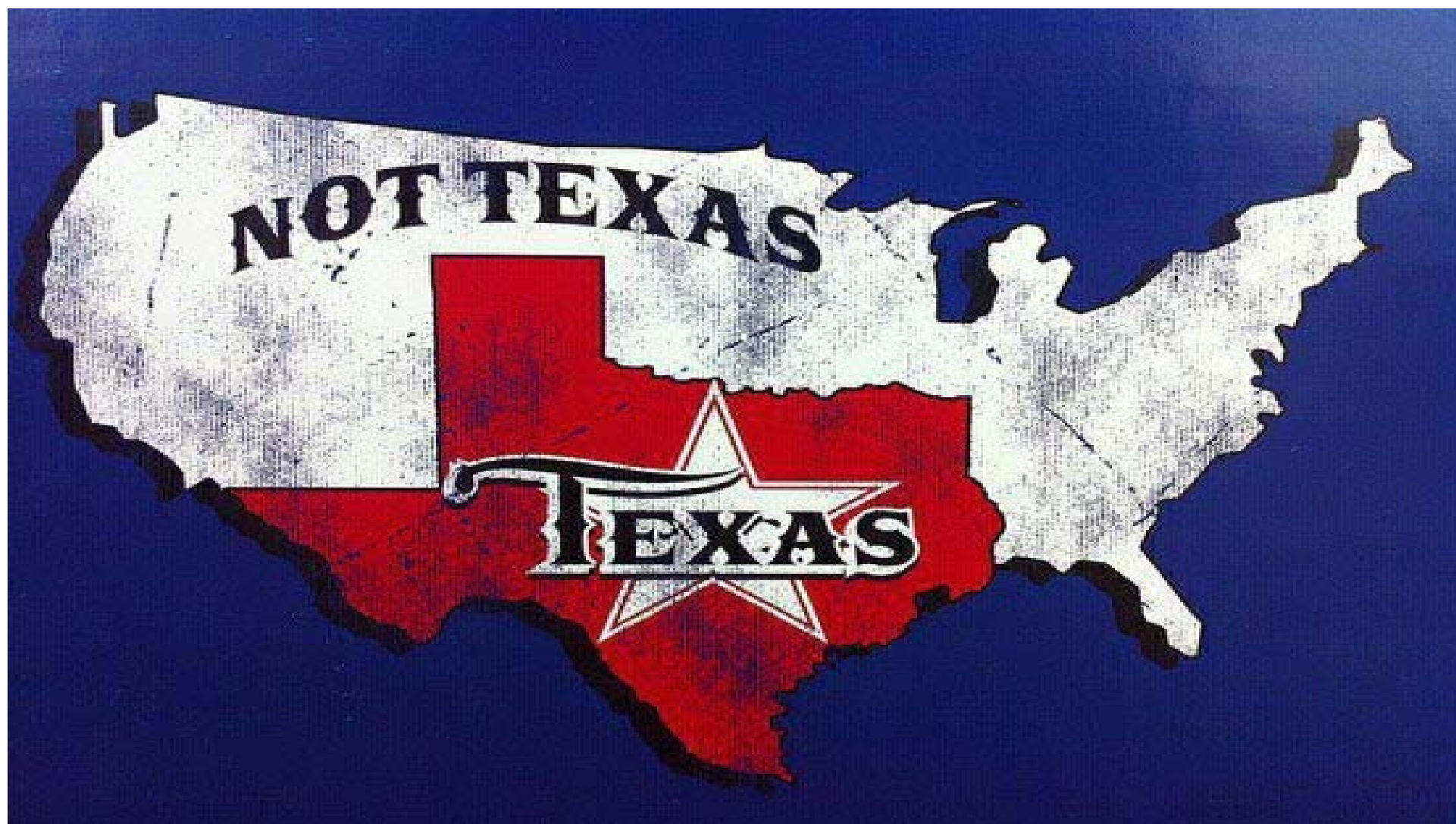
## OSIsoft - Leveraging Technology to Optimize Operations and Maintenance

August 23<sup>rd</sup> , 2012

David Thomason

Industry Principal – Global Power Generation

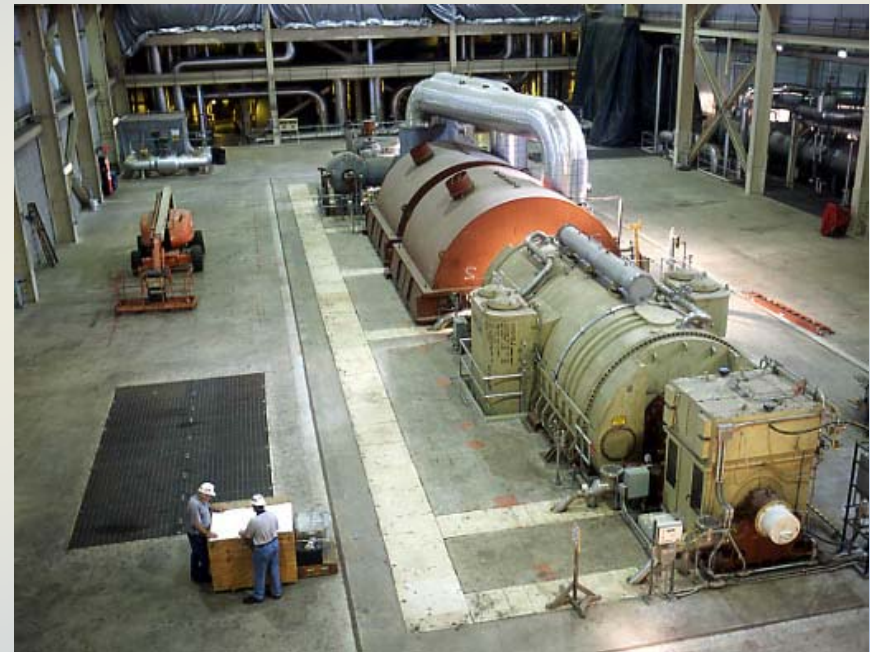






# Agenda / Topics

- OSIsoft and Generation
- Proactive Maintenance
- Operations
- APR



# Answers from Technology?



**IT WAS ME**  
I let the dogs out.

# No Such Thing as Too Much Information

- **Data Driven Decision Making**
  - Net gain on Output
  - Productivity 5 to 6 % higher



Reference: Brynjolfsson, et al., MIT, How does Data-Driven Decision making Affect Firm Performance, 2011.  
<http://www.nytimes.com/2011/04/24/business/24unboxed.html>

# PI System

## OSIsoft - Addressing Big Data Challenges



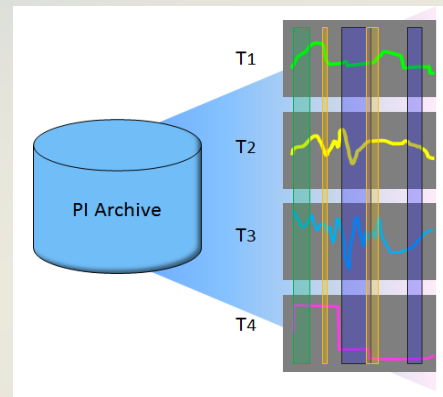
### Scaling

More data  
More updates  
More robust



### Asset-Centric PI

Manage data via  
Asset context –  
Reuse many times



### Event Frames

Identify and use  
important events  
and related data



### Visualization

Many roles  
Different formats  
Any device



## California ISO – “On the front Lines of the Power Grid” - New York Times, October 2011



***PJM – “Information Technology Unleashes the Electric Equivalent of a Free Keystone Pipeline” - Forbes - March 2012***

# Power Industry Challenges

- Power reserve margins are shrinking
  - Retirements of an aging coal fleet
  - Expansion of Shale gas low gas price = low power price
  - Economic conditions impacting new generation investments
- Regulatory Requirements (Security, Carbon, emissions monitoring...)
- Integration of renewables and their variability
- Plant and T&D life extensions and modernization
- Nuclear change in Japan, Germany
- CCGT pushing 60% plus efficiency
- China and India's expanding power use and economy
- Australia's mining boom and importance to keep the beer cold!
- Let's see how the "Power of Data" is helping solve these challenges

# Power Generation



## Thermal / Fossil Fuels

- Coal
- Gas
- Oil



## Nuclear

- Generation
- Fuel
- Regulators
- Services



## Renewable Energy

- Wind
- Solar
- Hydro
- Marine
- Bio
- Geo

Power Generation

# OSIsoft Power and Utilities Experience

## Monitored and Optimized with the PI system

- Approximately 60% of USA power generation
- 100% of the ISOs/RTOs in the North America
- 13 of the top 15 wind generating producers in the world
- 19.5GW of total 23 GW USA wind generation
- Over 50% of the Concentrated Solar Plants (CSPs) in the world
- 76% of USA nuclear power generators and the Nuclear Regulatory Commission
- 100% of nuclear power generators in Canada, UK & Korea



# The PI System - A "Defacto" Standard in Power Generation



# Driving Factors for PI Infrastructure



- Problem: Many disparate plant systems and the need to turn data into actionable information
  - DCS, PLC, CEMS, Analyzers...
  - Various timestamps
  - Data accessibility & integrity
- Solution: OSIsoft, Enterprise Wide Infrastructure
  - Common real-time database
  - Common visualization and analytic toolset
  - Common platform for notifications, development and advanced analytics
  - Leverage SMEs (Central, Plant, Vendors)
  - Remote Monitoring & Diagnostics

*Increase availability, lower lost margin*

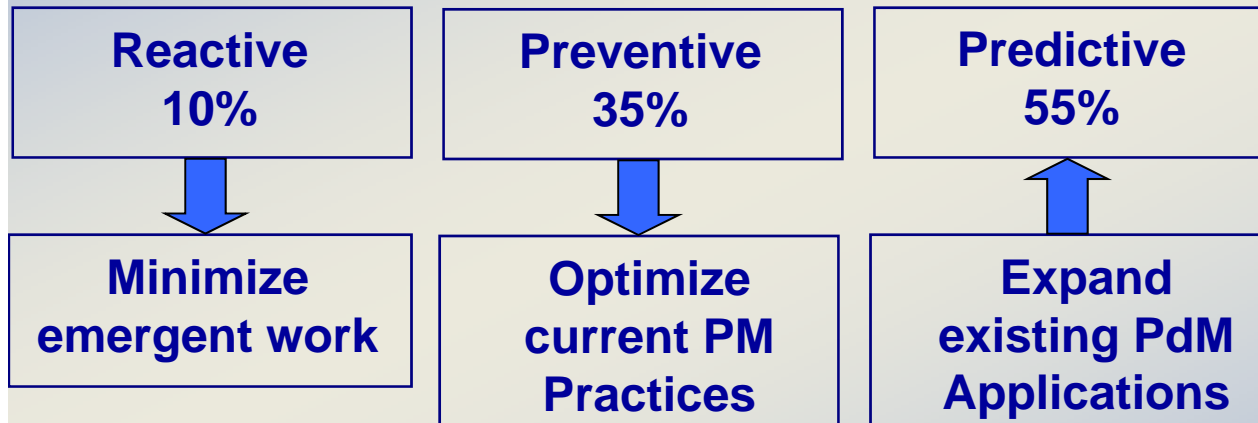
# Multi Uses for PI information

- Proactive and Condition Based Maintenance
- Operations (extend DCS beyond the Control Room)
  - Controllable Losses – Start Up / Shut Down
- Root Cause Analysis (RCA)
- Outage Planning (plan and spend on the right things)
- Vendor Performance (Pre and Post work review)
- Equipment / Manufacture Performance
- Plant and System Performance / Efficiency
  - Production vs schedule - Heat rate – Condenser – Turbine - Boiler / HRSG
- Environmental (Compliance, emissions, limits, reporting)
- Water Chemistry and Boilers
- Enterprise view of core metrics and KPIs
- Security (NERC CIP, ...) Passive access to Plant information
- Scheduling, Ancillary Services and Dispatch Optimization

*Single version of the truth*

# Proactive Maintenance

- Proactive Maintenance is a strategy in which Corrective, Preventive, and Predictive processes complement one another.
- The average industrial plant performs **more than 55% Reactive** maintenance work. Reactive is the highest cost!
- The top industrial plants perform **less than 10% Reactive** maintenance work. An industry “best practice” target goal maintenance mix



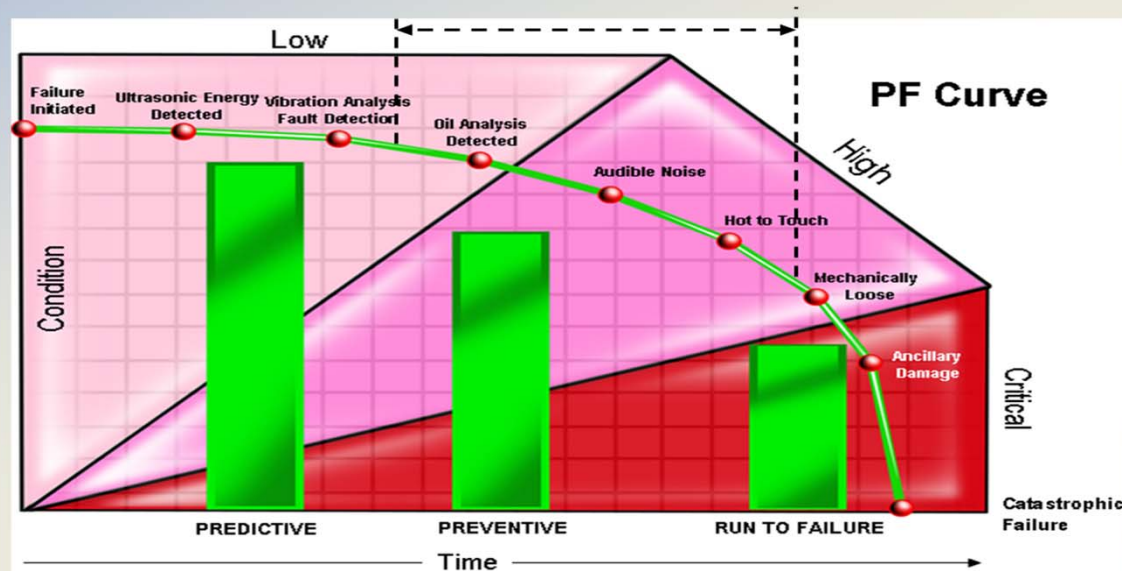
*- Strategy: enhance & expand the use of real time, historical data and analytics systems*



# Proactive Maintenance P-F Curve

The P-F curve is to show the behavior of equipment as it approaches failure.

- The P on the curve is the first possible point when equipment degrades or changes can be detected.
- The F is the point of equipment or system failure.
- The time between is your “opportunity” to avoid unplanned events



## P-F Interval

**Time frame to rectify impending equipment failure  
(Planning / Scheduling / Execution Window)**

**Earliest detection provides the greatest opportunity time**

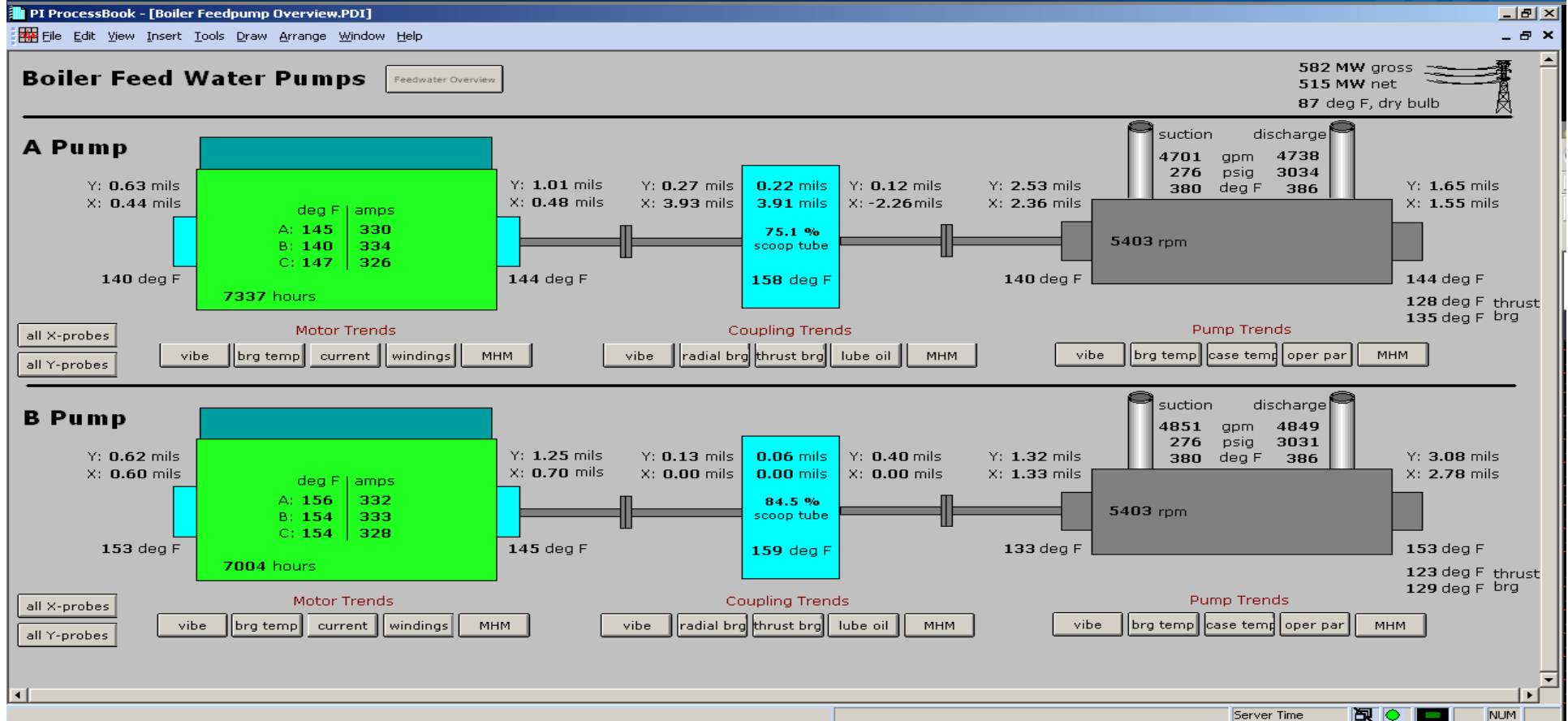
Source: Allied Reliability

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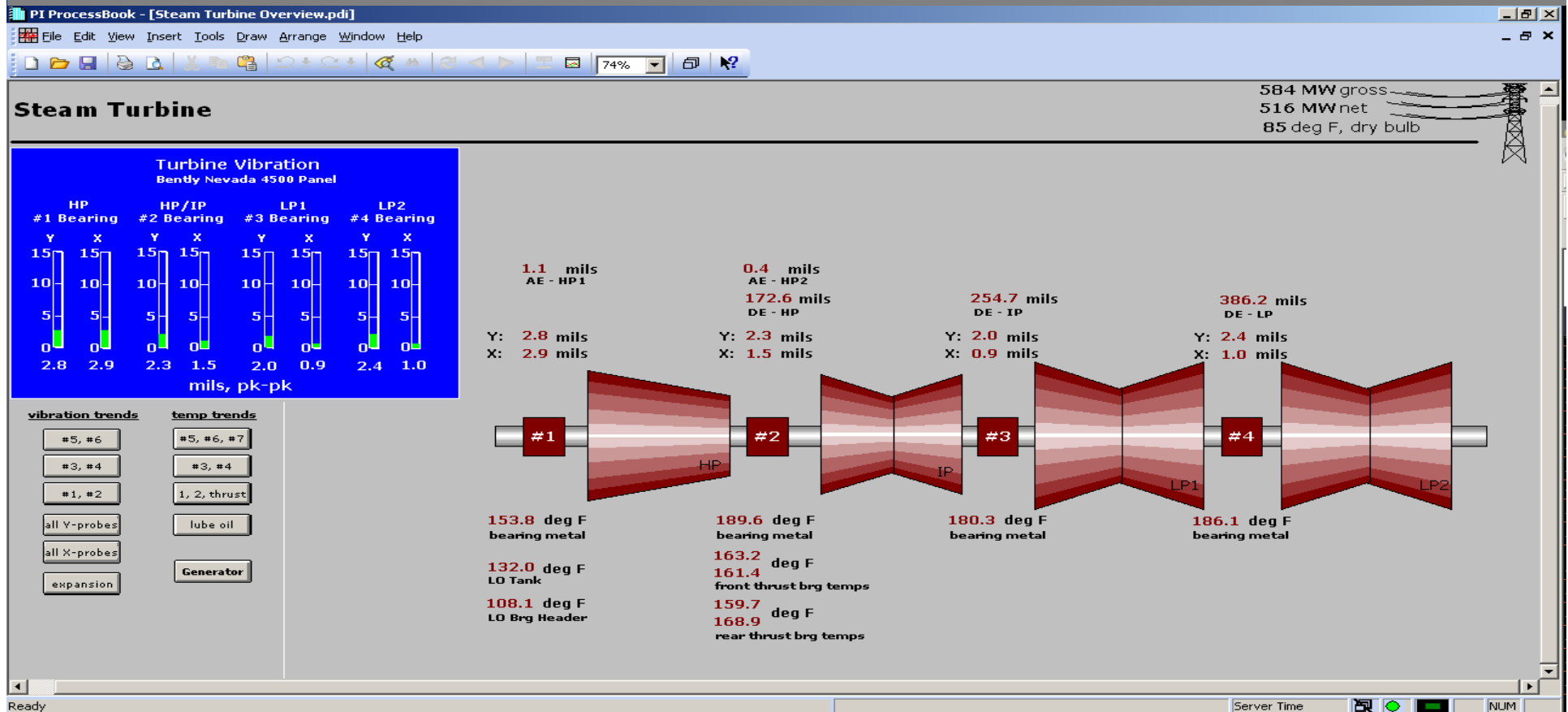
# Proactive Maintenance

- Screens and information with Maintenance in mind
- A focus on critical equipment, parameters for condition
  - Vibrations (rotating equipment, motors, pumps, turbine...)
  - Temperatures (bearings, oil, metal, motors...)
  - Amps
- Transform data and use in a new, valuable way
- Use out of the box, PI System functionality
  - Totalizers for run time counters, compare / balance usage, schedule maintenance, measure accumulative damage
  - Multi-state graphics
  - Notifications
- Increase speed and accuracy of decisions

# Proactive Maintenance Monitoring



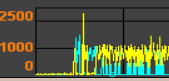
# Proactive Maintenance Monitoring

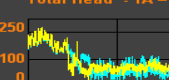




# Condition Based Maintenance Screens

**UNIT 1**  
149.13 MW

**Discharge Flow**  


**Total Head - 1A =**  


BFP 1A SUCT ST  
BFP 1A SUCT PF  
BFP 1A DISCH P  
BFP 1A DISCH F  
TOTAL HEAD  
THRUST HOUSIN  
NDE SLEEVE BR  
DE SLEEVE BRG

Get Runtime Tags

yes

12010: BFP 1A Runtime Hours when -BFP1A.RT  
12011: BFP 1B Runtime Hours when -BFP1B.RT  
12012: BFP 2A Runtime Hours when -BFP2A.RT  
12013: BFP 2B Runtime Hours when -BFP2B.RT  
12015: Condensate Pump A Runtime -COND\_A.RT  
12019: Condensate Pump B Runtime -COND\_B.RT

TagID	Tag Name	Tag Descriptor
12012	BFP2A.RT	BFP 2A Runtime Hours when

Value (Hours): 1996.35

Please add comment and initials.

Reset Runtime Counter

**Instructions:**

When the display loads it will pull back all \*.RT (Runtime Counter) tags from the stations PI Server.

- Click on the runtime counter from the listbox that you would like to reset.  
\* - The Counter Information will be populated in the display below the listbox.
- Reset the Runtime Hours value in the text box next to the Value.  
\* - You can set this to any number of hours.
- Add comments and name or initials to the comments textbox.
- Click the "Reset Runtime Counter" button.

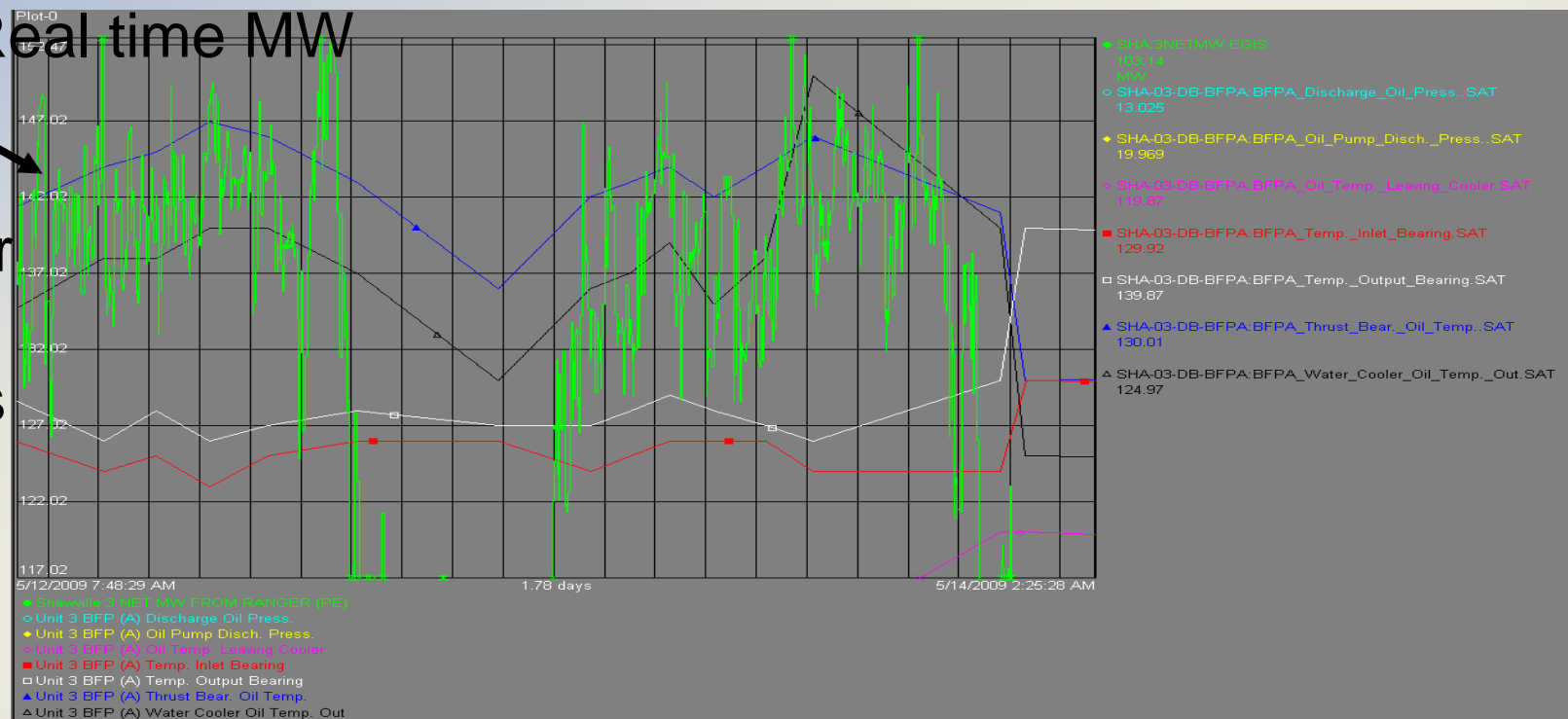
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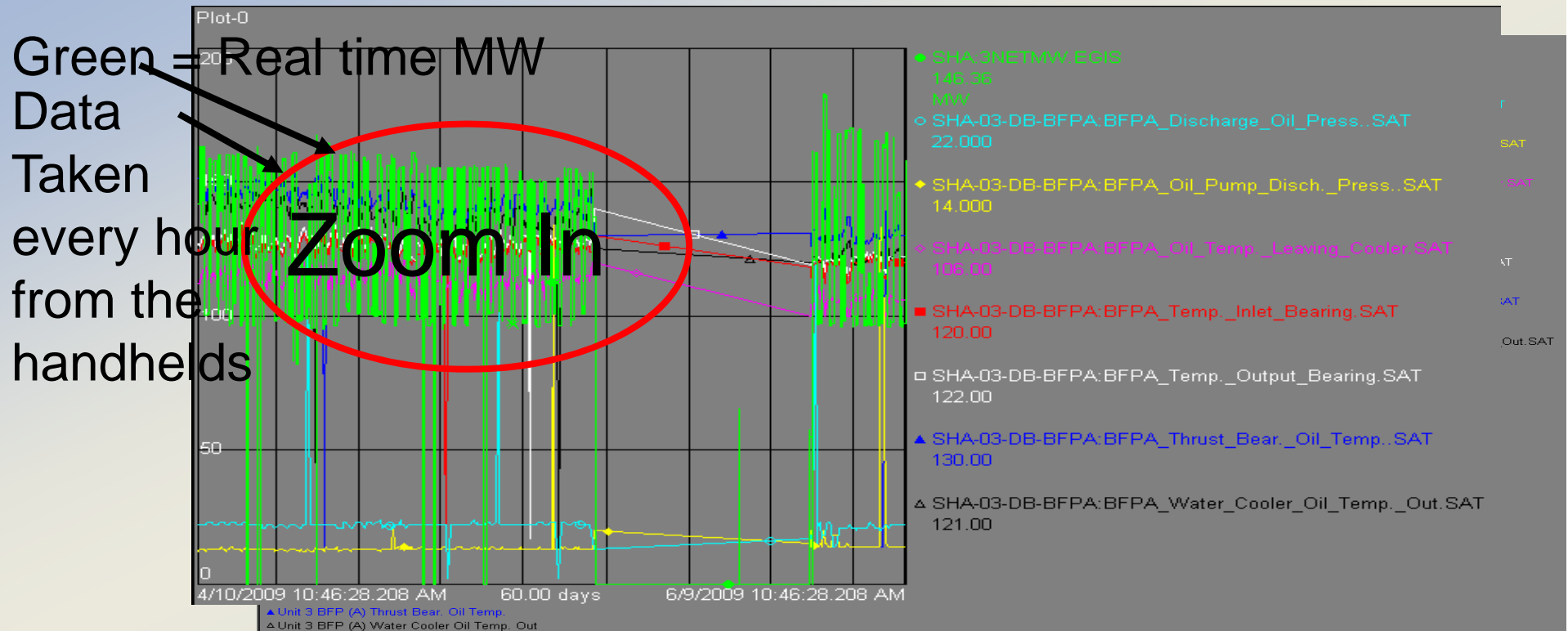
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# Manual Round Data Correlation

Green = Real time MW  
Data  
Taken  
every hour  
from the  
handhelds



# Manual Round Data Correlation



# Boilers – Highest Loss Margin System

***“The race car tire of Power Generation”***

***Most outages / de-rates are boiler related***

- Transformation of data to useful information

## ***Water Chemistry***

- Improve and interface to analyzers
- Cycle Water Chemistry screens
- Calculate minutes in / out of spec
- Notifications on limits
- Make visible via PI system



*Transform and use data in a new way...*



# Boilers – Highest Loss Margin System

## ***Boiler Tubes Temperatures***

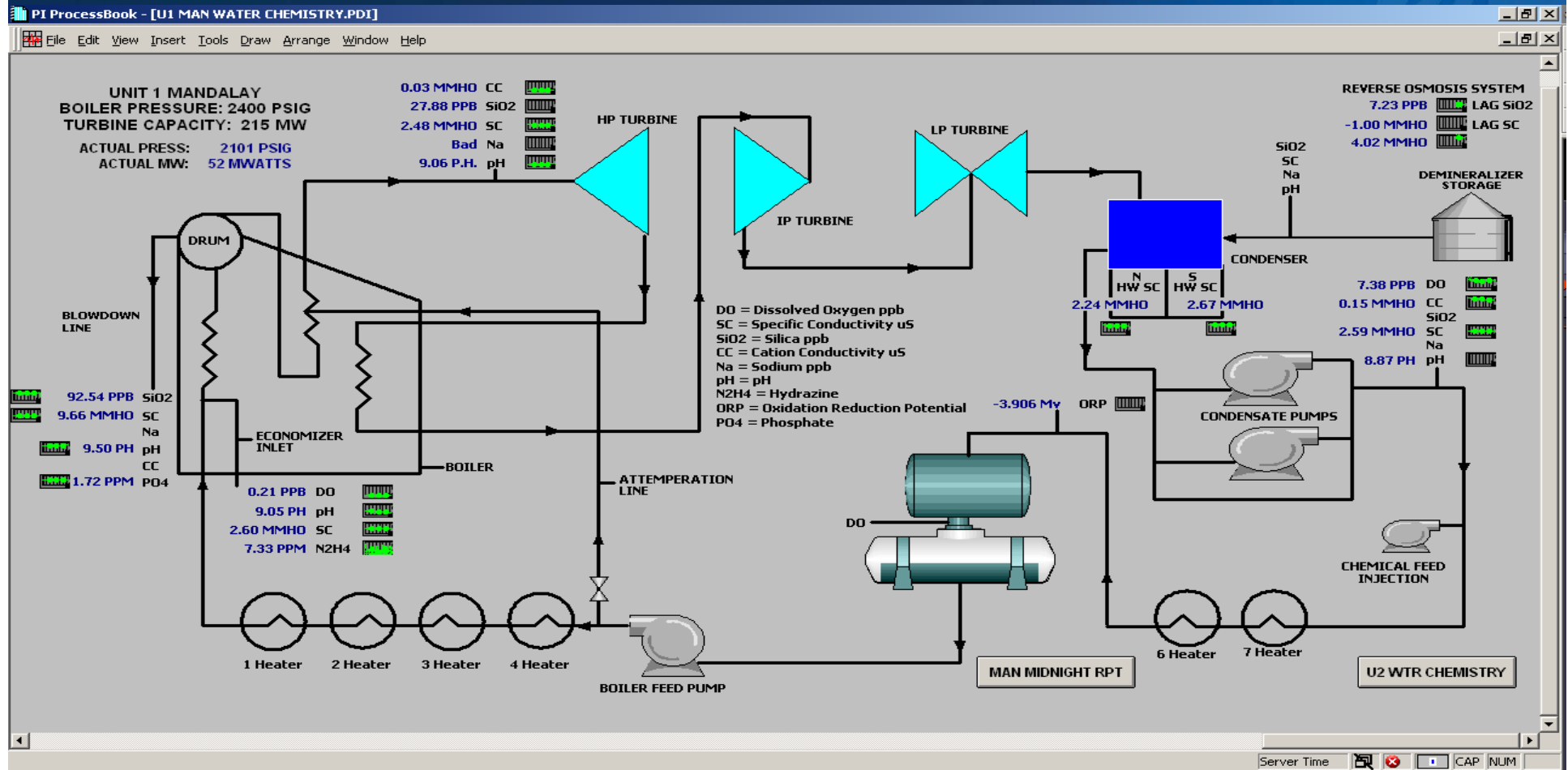
Systematically track:

- How many excursions?
- Length of excursions?
- Total time out of specification...
- Maintain instrumentation!



*Transform and use data in a new way...*

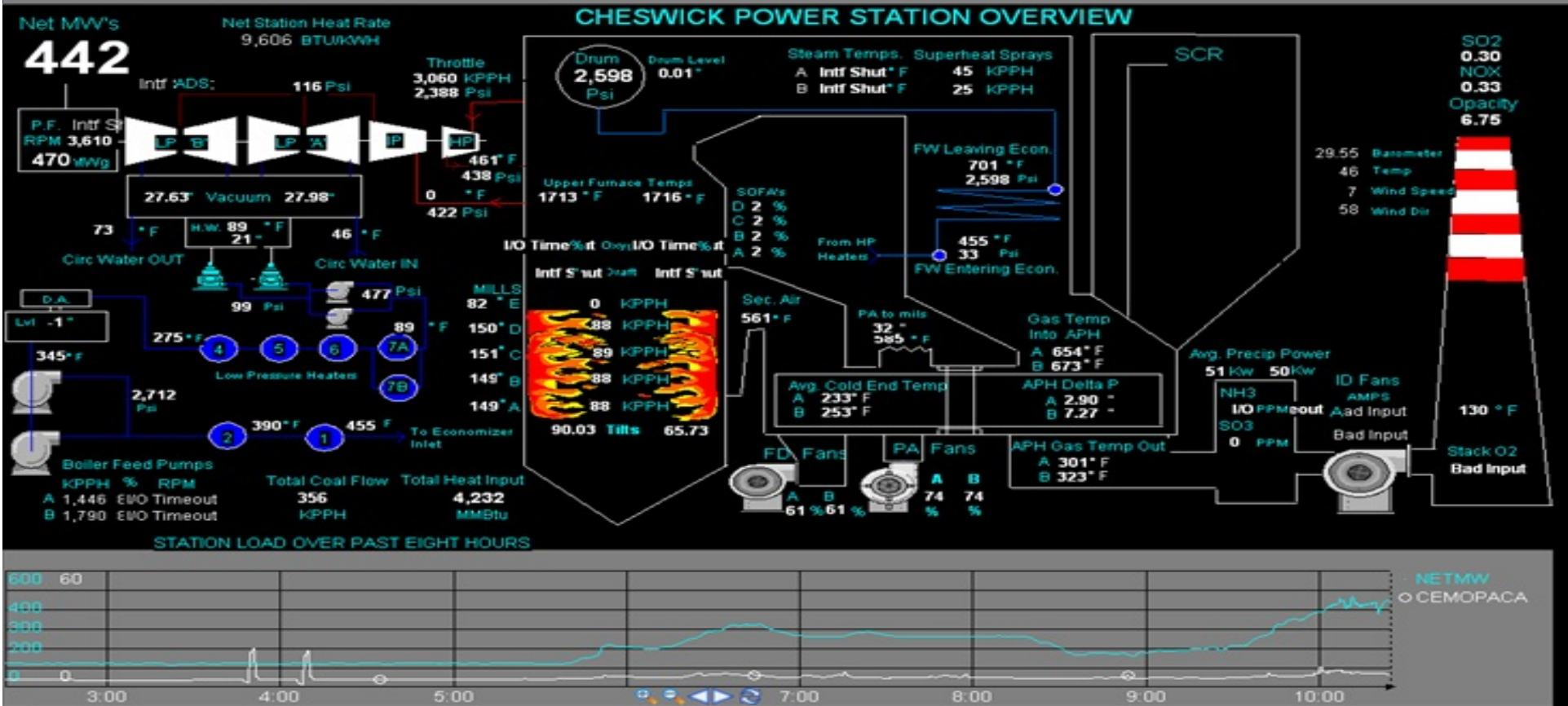
# Water Chemistry Displays



# Water Chemistry - Reports

			UNIT 1							
PARAMETERS:	EXPECTED RANGES		MIN FOR DAY	AVG FOR DAY	MAX FOR DAY	MINS IN NORMAL	MINS IN ACTION LVL 1	MINS IN ACTION LVL 2	MINS IN ACTION LVL 3	MINS IN ACTION LVL 4
<b>Condensate Pump Discharge</b>										
pH	9.2 - 9.6		9.40	9.43	9.46	1440.00	0.00	0.00	0.00	0.00
CC - CPD A, $\mu\text{S}/\text{cm}$	< 0.2		0.09	0.10	0.11	1440.00	0.00	0.00	0.00	N/A
Dissolved Oxygen, ppb	< 10		2.55	3.03	3.53	1440.00	0.00	0.00	N/A	N/A
Sodium, ppb	< 3		0.09	0.09	0.10	1440.00	0.00	0.00	0.00	N/A
<b>Boiler Feedwater</b>										
pH	9.2 - 9.6		9.31	9.32	9.33	1440.00	0.00	0.00	0.00	0.00
Cation Conductivity, $\mu\text{S}/\text{cm}$	< 0.2		0.04	0.04	0.04	1440.00	0.00	0.00	0.00	N/A
Specific Conductivity, $\mu\text{S}/\text{cm}$	4 - 11		7.86	7.90	7.99	1440.00	0.00	N/A	N/A	N/A
Dissolved Oxygen, ppb	1 - 10		8.57	8.99	9.82	1440.00	0.00	0.00	0.00	N/A
Sodium, ppb	< 3		0.12	0.13	0.15	1440.00	0.00	0.00	0.00	N/A
<b>Boiler Water (Drum Blowdown)</b>										
pH - T1Drum Blowdown A	9.2 - 9.6		9.13	9.16	9.21	158.35	1281.65	0.00	0.00	0.00
CC - T1 BLR 1 Water	< 1.0		0.20	0.22	0.24	1440.00	0.00	0.00	0.00	N/A
SC - T1 Drum Blowdown	4 - 11		5.26	5.30	5.38	1440.00	0.00	N/A	N/A	N/A
Silica - T1, ppb	< 60		41.69	44.11	49.17	1440.00	0.00	0.00	0.00	N/A
Sodium - T2, ppb	< 300		3.89	10.22	20.74	1440.00	0.00	0.00	0.00	N/A
<b>Saturate Steam (Drum Steam)</b>										
CC - T1 Drum Steam, $\mu\text{S}/\text{cm}$	< 0.2		0.13	0.14	0.15	1440.00	0.00	0.00	0.00	N/A
Degas CC - T1 Drum Steam, $\mu\text{S}/\text{cm}$	< 0.2		0.09	0.09	0.09	1440.00	0.00	0.00	0.00	N/A
SC - T1 Drum Steam, $\mu\text{S}/\text{cm}$	4 - 11		7.70	10.28	16.36	1027.47	412.53	N/A	N/A	N/A
Silica - T1, ppb	< 10		3.81	4.07	4.83	1440.00	0.00	0.00	0.00	N/A
<b>Main Steam</b>										
Degas Cation Conductivity, $\mu\text{S}/\text{cm}$	< 0.15		0.10	0.10	0.11	1440.00	0.00	0.00	0.00	N/A
Silica, ppb	< 10		4.99	5.51	6.39	1440.00	0.00	0.00	0.00	N/A
Sodium, ppb	< 2		0.11	0.12	0.13	1440.00	0.00	0.00	0.00	N/A

## Operations



# Non-routine Operations : Start-Up

**START UP** Ramagundam U#3

## PRE START CHECKS

H2 Pr: 1.85Kg/cm2	1.97473
H2 Purity>98%	98.9995
MOT Level LO	NOT_LOW
Lube oil temp: 45 deg	46.8300
Vacuum	-693.366
Gind stm temp>280Deg	239.405
M S line charged	151.630
HP/LP charged	OUT_OF_SERVICE
Dea stm charged	8.10537
Drum Lvl	-15.5041
Dea Lvl	2423.75
Hotwell Lvl	447.221
Turning Gear :	DISENGAGED

## Rolling Parameter

MS Pr : 75 Kg/cm2	151.630
MS temp: 350 deg	538.275
HRH Pr: 12 Kg/cm2	24.5788
HRH temp: 320 deg	521.469
Boiler PH	7.70544
Cond cation cond.	0.12395

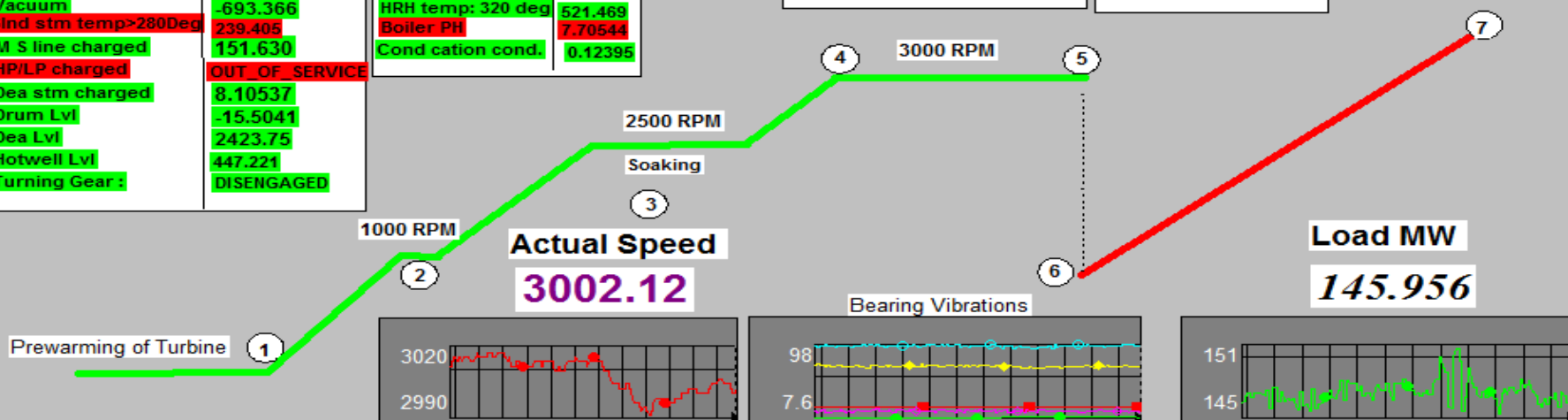
Oil Injection test  
Electrical test  
Total time at 3000 rpm  
Time From step 4 to 5: 6 Hours

## Check 5

AVR Auto	Auto
H2Cold gastemp	36.1253
Seal oil temp	35.4081

## BLK 4,5 FINAL RAMP STABLISN

Raise full load: 200 MW @ 1.5 MW



## Check 1

Barring Speed: 3 to 5 RPM	3002.12
EHC in service	NOT_MALFUNCTION
Criteria: ESV opening	
Main Stm to CV Chest DT < 50 deg	
Criteria: CV opening	
HP inner Shell Metal Temp > 165	
Speed raising to 1000 rpm	

## Check 2

Turbine Speed: 1000 RPM	3002.12
All Vibrations Within Limit	
Check for all Bearing temp normal	
Speed raising from 1000 to 2500 rpm	

## Check 3

Criteria : Speed raising 3000 rpm	
- AccIn rate 100 rpm	0
-HRH pr 12 kg/cm2	
Block Load : 10 MW	
AOP cut out 2800 rpm	OFF

## Check 7

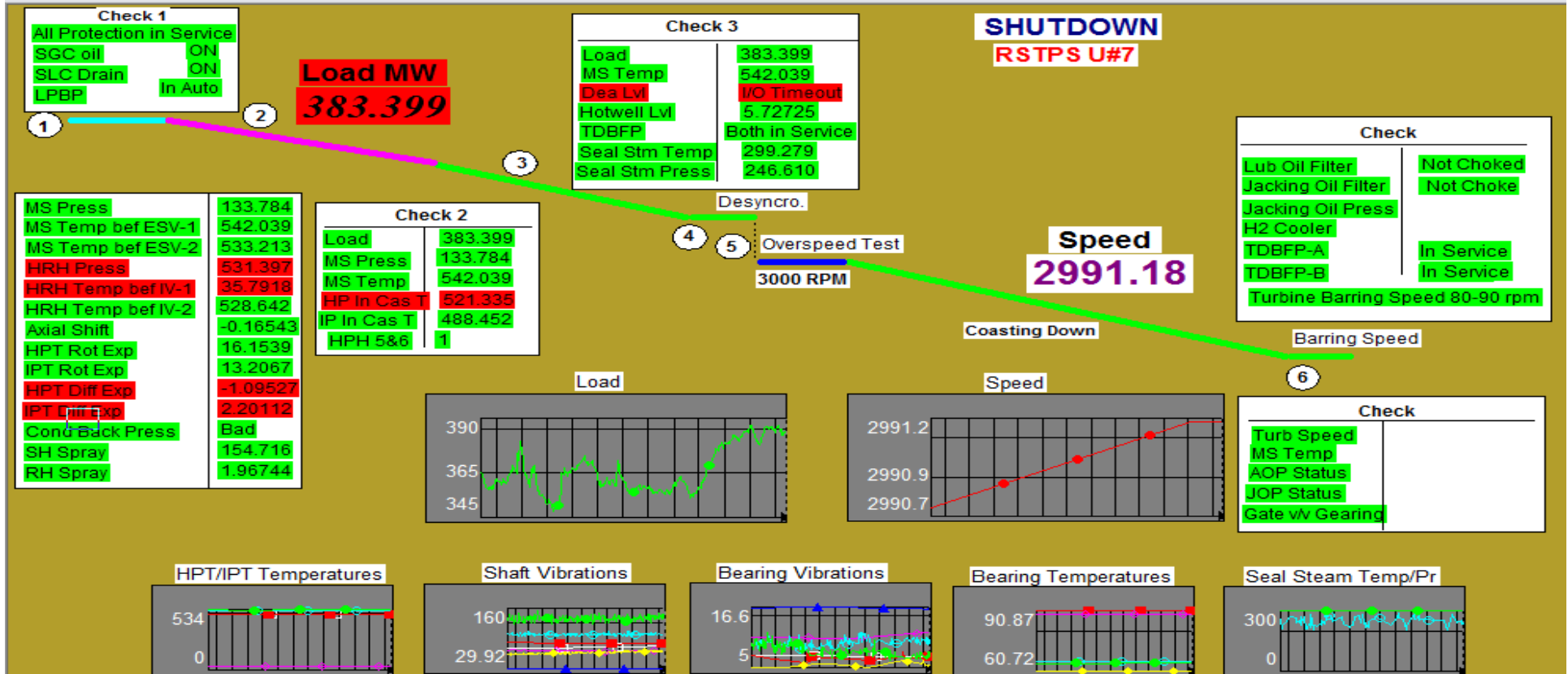
Load Raising from Block load to 200 MW	
Cross Over Pipe Inner Metal Temp. >= 175 Deg	
For 60 Minutes	
HP Heaters Charged	-1.14373

ROLLING

BLOCKWISE



# Non-routine Operations : Shut-Down



# Operations - Controllable Loss

## ETW 4 OPERATOR CONTROLLABLE LOSS

10/16/2009 17:04:03  
Net MW: 249

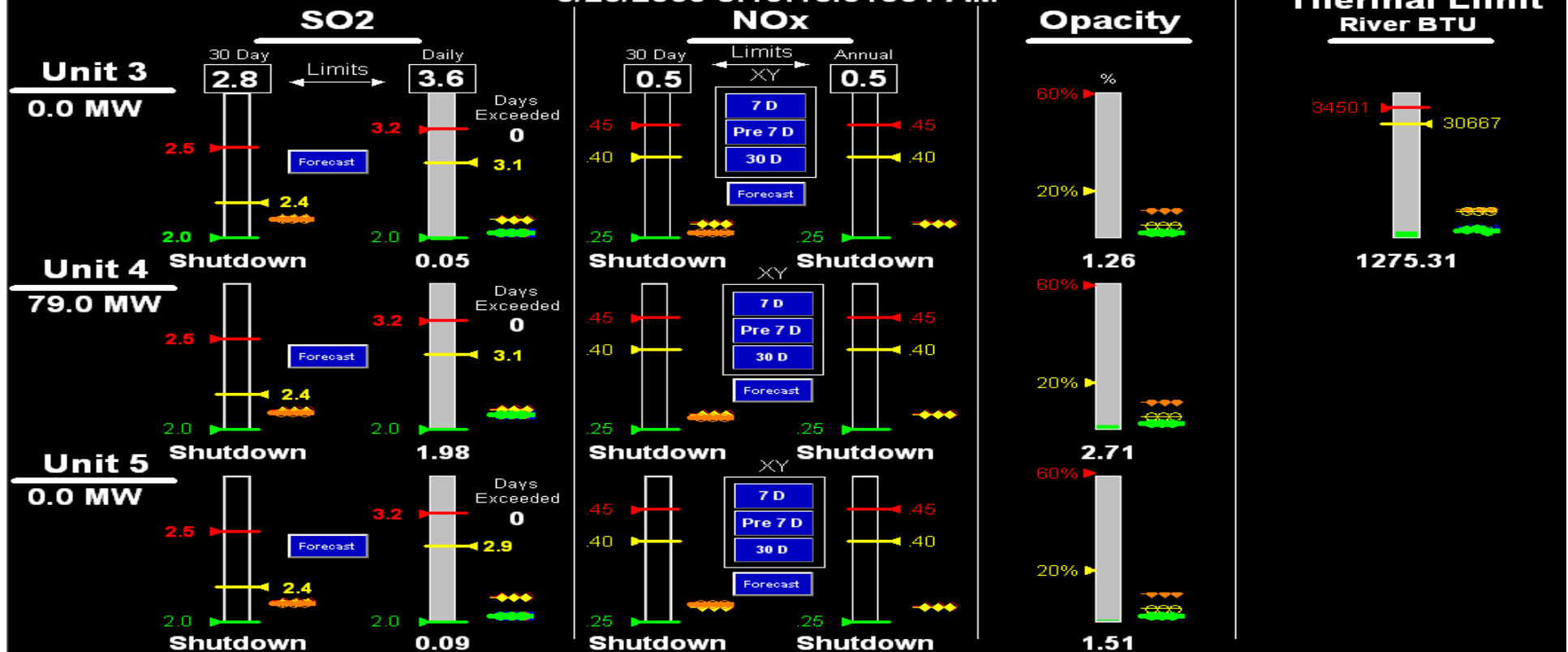
Controllable Variable	UNITS	ACTUAL	DESIGN	+500	DEVIATION (HR)	-500	HR	MW
Main Steam Pressure	PSIG	2404	2415				-14	-0.3
Main Steam Temps	°F	1040	1050				15	0.4
SH Attenuation Flow	klb/hr	Bad Inp	0					
Hot RH Steam Temps	°F	992	1000				13	-0.9
RH Attenuation Flow	klb/hr	40.42	0					
Condensate Subcooling	°F	2.5	4.0 max					
Excess O2 *	%	2.04	1.80					
Stack Temp	°F	256.8	238.2					
Auxiliary Power	MW	7.09	9.50					
Backpressure	in Hga	3.37	2.00				447	-10.3
Vacuum	in Hg	26.55						
Heat Rate	btu/kwh	10644	10306				338	



# Environmental Monitoring

## Environmental Monitoring Summary

5/20/2009 8:19:13.01501 AM



# Advanced Pattern Recognition (APR) Modeling

Predictive Analytics leverages the PI system

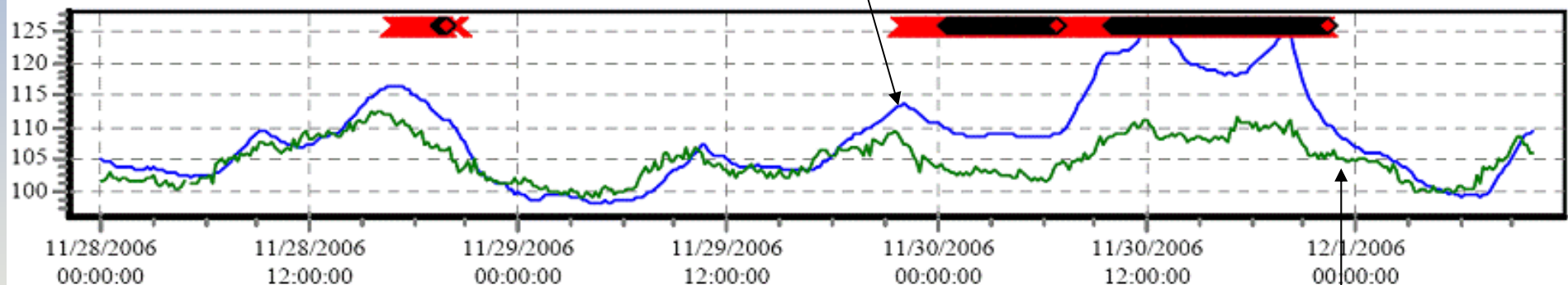
- *Computers working for you!*
- Reduces Manual Monitoring
- Detects anomalies on critical equipment and systems
- Early detection of slow developing failure
- Multiple sensor models, not just a single signal
  - Avoiding failures
  - Supporting Operations
  - Optimizing Maintenance

*Rules based monitoring of critical systems.  
Computer models watching the data all the time*

# Fan Motor Bearing

Temperature movement on FD Fan Motor outboard bearing (about 17 degrees above expected currently).

3D124-3TE273, WEST FD FAN MTR OUTBD BRG (DEGF)



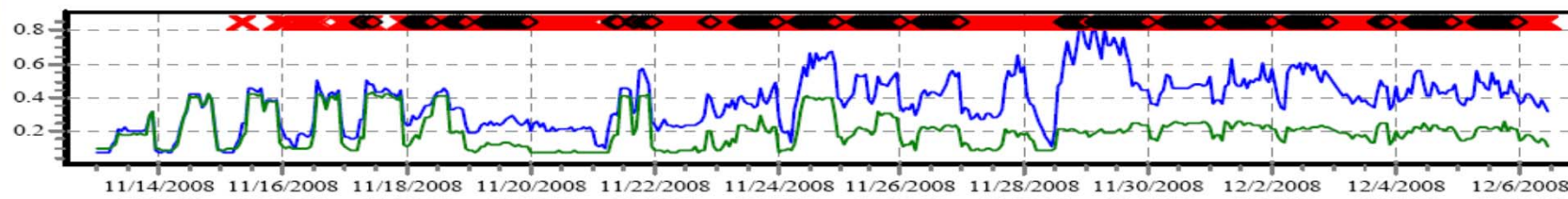
After detection, the filters were found dirty, replaced, and the real time oil level and temps are dropping back to the model expected value.



# Correlated Data – “Get everything”

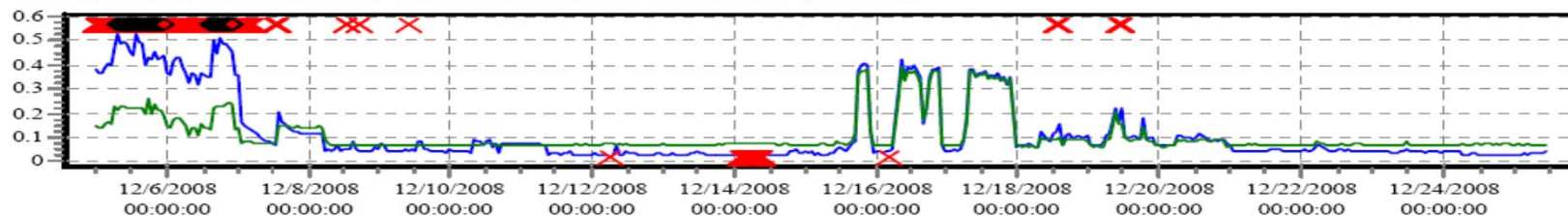
**Background:** A boiler acoustic detector system was interfaced into PI. A model was created from the new correlated data. Leveraging common notifications and analytics, a leak was detected in unit penthouse.

DX4\_CH23, Penthouse Acoustic Leak Detector (Volts)



**Resolution:** While the unit was offline, a small tube leak was discovered in the penthouse. The leak was repaired, avoiding a potential forced outage.

DX4\_CH23, Penthouse Acoustic Leak Detector (Volts)



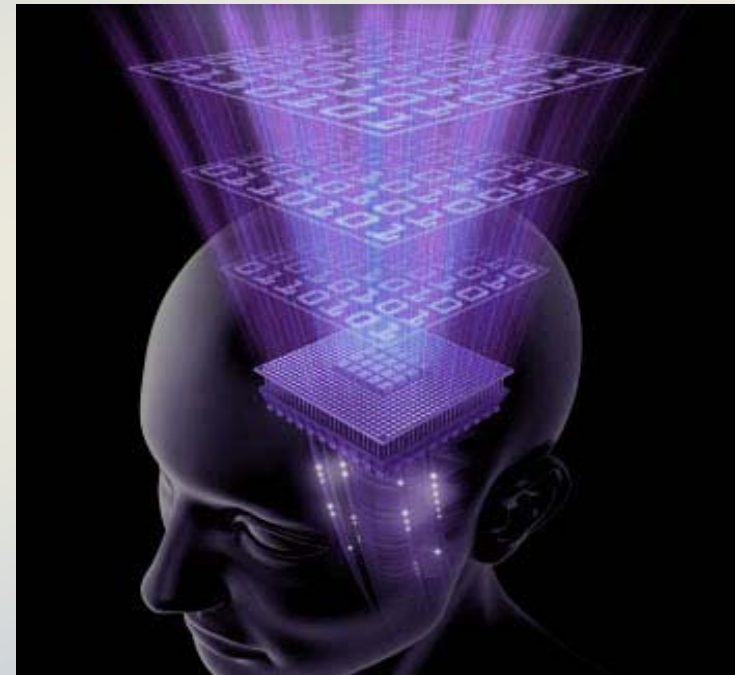
# For Generation...

Every OSIsoft PI deployment phase has positive return for Power Generation  
Implement a correlated Plant real-time data and event Infrastructure

- *“get everything” at the plant, create a comprehensive, time synched correlated database (DCS, analyzers, vibrations, CEMS, PLCs, weather, mkt prices...)*
- *Make it available... Screens, reports, notifications,...*
- *Leverage for core business processes*
  - *Operations, Maintenance, and Engineering*
- *Cost effective instrumentation projects*
- *Develop applications and partner solutions*
- *Advanced Analytics*
- *Elevate into KPIs and ERP / EAM Systems*

# OSIsoft “Power Of Data”

- All data in real time with context and history
- Decision Making is:
  - Faster
  - More Accurate and Complete
  - More Effective
- Preserve and expand knowledge
- Enable situational predictability
- Increase speed of execution
- Cultivate and leverage the collective “mind” power of the organization



# **OSIsoft – Fast and Agile**

**We are here to help!**

# Thank You and Q&A

## Question & Answer

***David A. Thomason***

OSIsoft, LLC

Business Development Executive – Global Power Generation

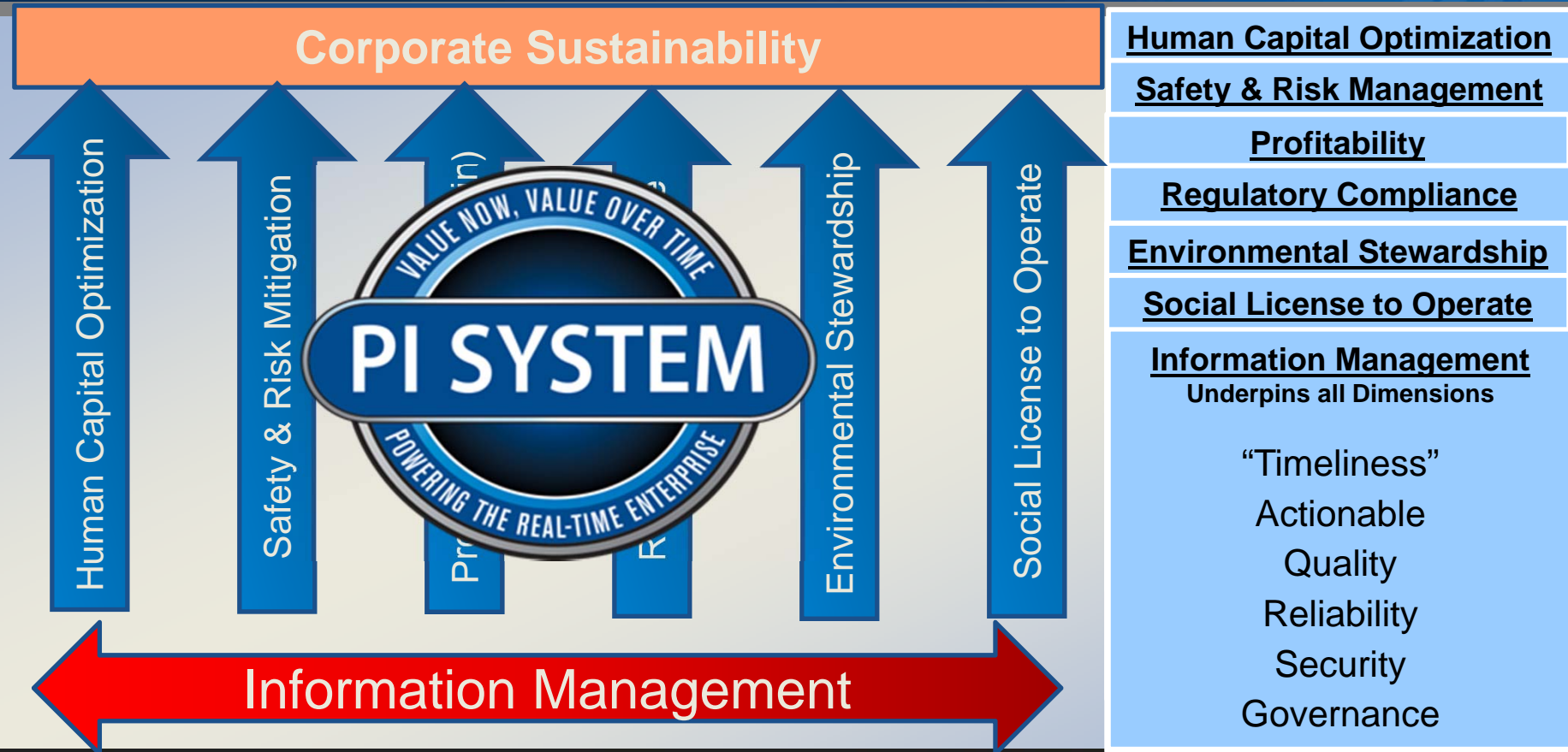
phone: 713-858-5585

[dthomason@osisoft.com](mailto:dthomason@osisoft.com)





# The 7 Dimensions of Corporate Sustainability





# THANK YOU

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